July 2014 Name ______________________________

Unit 1 Test

Expectation	Level
B1 - analyse technological devices that apply the principles of the dynamics of motion, and assess the technologies' social and environmental impact;	
B3 - demonstrate an understanding of the forces involved in uniform circular motion and motion in a plane.	
General Feedback	

TRUE/FALSE (level 1)
Please indicate true or false by writing the complete word beside each statement

	An object is thrown vertically upward. At the top of its flight, when its velocity is momentarily zero, its acceleration is *zero*
	A plane's destination is due east of its departure point. If a steady wind is blowing from the north-west, the plane must point *south-east* to reach its destination
	The normal force $\vec{F}_N$ that acts on an object is *always equal* in magnitude and opposite in direction to the gravitational force $\vec{F}_G$ that is acting on it
	Newton's third law states that forces always act in pairs but the two forces of any pair *act on different objects*
	For an object travelling with uniform circular motion, its acceleration is always directed *tangent to the circle*
	A rock is tied to a string and whirled around in a circle that describes a vertical plane. The *tension in the string is greatest at the bottom of the circle* and least at the top
	Speed is the same as velocity without the direction
	When a ball is rising upward after you toss it vertically, *the net force on the ball is equal to the force of gravity on the ball*

MULTIPLE CHOICE (level 2)
Please indicate the letter of your answer in the column beside each question

	Which of the following is NOT an example of "inertia"? a. A person's head jerks back as the car he is riding in accelerates forward. b. A person's head jerks forward as the car he is riding in suddenly stops. c. A person is pressed up against the car door as the car turns a corner. d. A person is largely unaware of a car's motion when his eyes are closed. e. All of the above are examples of inertia.
	Which of the following situations would produce the greatest acceleration? a. A 1.0-N force acting west and a 2.0-N force acting east on a 1.0-kg object. b. A 3.0-N force acting west and a 5.0-N force acting east on a 2.0-kg object. c. A 8.0-N force acting west and a 5.0-N force acting east on a 3.0-kg object. d. A 8.0-N force acting west and a 12.0-N force acting east on a 4.0-kg object. e. A 1.0-N force acting west and a 9.0-N force acting east on a 5.0-kg object.

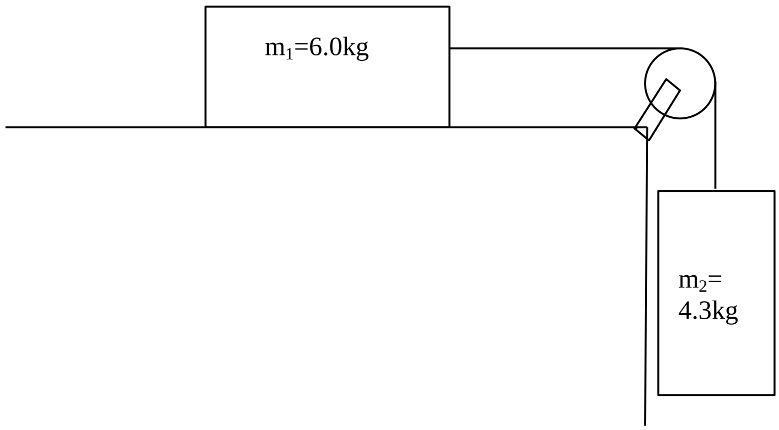
	An object sits at rest on a ramp. As the angle of inclination of the ramp increases, the object suddenly begins to slide. Which of the following explanations best accounts for the object's movement? a. The coefficient of static friction has decreased sufficiently. b. The force of gravity acting on the object has increased sufficiently. c. The component of gravity along the ramp has increased sufficiently. d. The friction has decreased sufficiently while the normal force has remained unchanged. e. The normal force has increased sufficiently.
	A 2.0-kg object is pulled horizontally by a force of 6.3 N along the floor where the coefficient of kinetic friction is 0.24. What is the object's acceleration? a. 5.5 m/s^2 d. 1.6 m/s^2 b. 2.0 m/s^2 e. 0.80 m/s^2 c. 2.0 m/s^2
	Imagine that you are travelling in a train and you have a drink sitting on the dining table in front of you. The train suddenly stops and the drink ends up in your lap. What force acting on the drink is responsible for its sudden motion? a. the force of the table acting on the drink b. the force of the track on the wheels c. the force of the wheels on the track d. the force of the drink on itself e. There is no force acting on the drink that is responsible for its motion.
	For an object travelling with "uniform circular motion," a. its velocity is constant b. its acceleration is always directed tangent to the circle c. its velocity is always directed toward the centre of the circle d. its speed and distance from the centre of the circle are constant e. its speed may change provided the radius of the circle is constant

SHORT ANSWER (level 4 possible)

Explain Newton's 3 Laws by giving a "real life" example of each

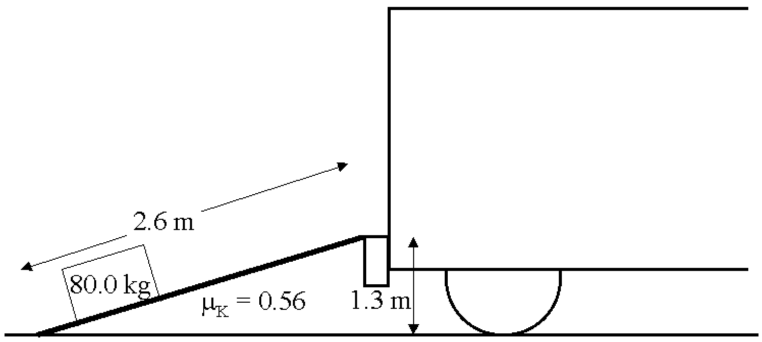
PROBLEM SOLVING

Question 1 **(level 3)**
Two masses are connected by a light cord over a frictionless pulley, as shown below. If the coefficient of kinetic friction is 0.13, determine the acceleration of the system and tension in the cord.



Question 2 (level 3)

Crates of mass 80.0 kg are loaded onto a truck, a vertical lift of 1.3 m. To make the work easier, a 2.6 m long ramp is used and the crates are pushed along the ramp from the ground onto the truck. The coefficient of friction between the crates and the ramp is 0.56.



(a) Determine the minimum force required to push a crate along the ramp. Include an appropriate free-body diagram.
(b) If a crate is let go from rest at the top of the ramp and begins to slide, how long will it take to reach the bottom of the ramp? Include a new free-body diagram.
(c) What minimum value for the coefficient of static friction will prevent the crate from beginning to slide if it is let go at the top of the ramp?

<u>Question 3</u> (level 4)

A 200g mass is tied on the end of a 1.6 m long string and whirled around in a circle that describes a vertical plane.

(a) What is the minimum frequency of rotation required to keep the mass moving in a circle?

(b) Calculate the maximum tension in the string at this frequency.

<u>Question 4</u> (level 4)

A 1000-kg Indy car travels around a curve banked at 25° to the horizontal. If the radius of the curve is 80 m, at what speed must the car be traveling if no friction is present? State your answer in m/s and km/h.

<u>Question 5</u> (level 4)

During training, an aerial skier takes off from a ramp that is inclined at 40.0° to the horizontal and lands in a pool that is 10.0m below the end of the ramp. If she takes 1.50s to reach the highest point of her trajectory, calculate:

a.) the speed at which she leaves the ramp

b.) the maximum height above the end of the ramp that she reaches

c.) the time for which she is in the air

<u>Question 6</u> (level 3)

A dog walks at 1.6 m/s on the deck of a boat that is traveling north at 7.6 m/s with respect to the water.

a. What is the velocity of the dog with respect to the water if it walks towards the front of the ship?
b. What is the velocity of the dog with respect to the water if it walks towards the back of the ship?
c. What is the velocity of the dog with respect to the water if it walks towards the east rail?

Useful Equations

Kinematics

$$v_{av} = \frac{\Delta d}{\Delta t} = \frac{v_1 + v_2}{2}$$

$$a_{av} = \frac{v_2 - v_1}{\Delta t}$$

$$v_2 = v_1 + a\Delta t$$

$$\Delta d = v_1\Delta t + \frac{1}{2}a\Delta t^2$$

$$\Delta d = \frac{(v_1 + v_2)\Delta t}{2}$$

$$\Delta d = v_2\Delta t - \frac{1}{2}a\Delta t^2$$

$$v_2^{\ 2} = v_1^{\ 2} + 2a\Delta d$$

Dynamics

$$F_g = mg$$

$$F_g = \frac{Gm_1m_2}{\Delta d^2}$$

$$F_f = \mu F_N$$

$$F_{net} = ma$$

$$F = kx$$

$$a_c = \frac{v^2}{r}$$

$$F_c = ma_c = \frac{mv^2}{r}$$

$$\tan\theta = \frac{v^2}{gr}$$

$$g = \frac{GM}{R^2}$$

$$\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$$

$$a_c = \frac{4\pi^2 r}{T^2} = 4\pi^2 r f^2$$